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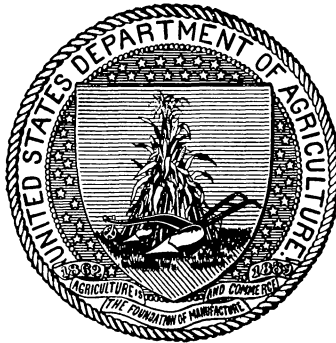
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# WINTER OATS FOR THE SOUTH.

BY

C. W. WARBURTON,

*Agronomist in Charge of Oat Investigations,  
Bureau of Plant Industry.*



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# LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
OFFICE OF THE CHIEF,  
Washington, D. C., December 31, 1910.

SIR: I have the honor to transmit and to recommend for publication as a Farmers' Bulletin the accompanying manuscript, entitled "Winter Oats for the South," prepared by Mr. C. W. Warburton, Agronomist in Charge of Oat Investigations, under the direction of Mr. W. A. Carleton, Cerealist in Charge of Grain Investigations.

The growing of winter grains is an important part of the diversification of crops in the South. Winter oats is one of the best of the winter grains for general use, but under ordinary methods of culture the crop frequently winterkills or returns unsatisfactory yields. Methods are described in this bulletin by which the loss from winterkilling may be largely obviated and the yields materially increased. It is believed that this information will be of general interest to southern farmers.

Respectfully,

WM. A. TAYLOR,  
*Acting Chief of Bureau.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*

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# WINTER OATS FOR THE SOUTH.

## INTRODUCTION.

Some of the problems in the production of winter oats in the Southern States are quite different from those which must be solved by the grower of spring oats in the northern and central portions of the United States. Not only are the varieties different, but the proper selection of soils and fertilizers and the time and manner of seeding to secure the best results in the production of the crop are quite at variance with the best practices in the sections where spring oats are extensively produced. The methods of growing spring oats and the uses which can be made of the oat crop have been discussed in previous publications.<sup>a</sup> In this bulletin it is proposed to outline the best methods for the production of winter oats in the Southern States.

## PRODUCTION OF OATS IN THE SOUTHERN STATES.

The production of winter oats is more or less practicable throughout the sections usually known as the South Atlantic and South Central States, which, for convenience, will be referred to in this publication as the Southern States, although they include some to which that term is not usually applied. In these States the production of oats averaged a little more than 74,000,000 bushels for the ten years 1900–1909. The Bureau of Statistics of the Department of Agriculture does not report the acreage of winter and spring oats separately, so it is impossible to estimate the proportion of the two crops. The annual production in the United States for this period averaged

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<sup>a</sup> Farmers' Bulletins 424, entitled "Oats: Growing the Crop," and 420, "Oats: Distribution and Uses." Farmers' Bulletin 395, entitled "Sixty-Day and Kherison Oats," discusses two varieties of spring oats adapted to the corn belt. Circular 30, Bureau of Plant Industry, entitled "Improvement of the Oat Crop," outlines methods for improving oats, with the details of a plan for testing individual selections. All these publications will be sent free of cost upon request to the Secretary of Agriculture, Washington, D. C.

870,000,000 bushels, so that about 8.5 per cent of the crop was produced in the South. During these ten years the average area devoted to oats in the United States was nearly 30,000,000 acres, of which 3,400,000 acres, or about 11.5 per cent, were in the South. The average yield to the acre was only 21.8 bushels, as compared with 29.5 bushels for the entire country, which shows why the South produced only 8.5 per cent of the crop on 11.5 per cent of the area. Owing to the high price per bushel, 46.4 cents, as compared with 35.5 cents for the entire United States, the acre value, \$10.09, was little less than that for the entire country, \$10.26.

The acreage, production, and value of oats in each of the Southern States for the ten years 1900-1909 are shown in Table I.

TABLE I.—Average acreage, production, and value of the oat crop in the Southern States for the ten years 1900-1909, inclusive.

State.	Acreage.	Yield per acre.	Production.	Price per bushel on Dec. 1.	Total farm value on Dec. 1.	Value per acre on Dec. 1.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Bushels.</i>	<i>Cents.</i>		
Delaware.....	5,554	25.3	134,244	42.8	\$54,693	\$10.96
Maryland.....	38,778	25.1	961,902	41.1	381,427	10.32
Virginia.....	209,237	17.6	3,598,184	44.8	1,603,720	7.93
West Virginia.....	94,735	22.1	2,082,669	45.1	926,602	9.91
North Carolina.....	226,458	14.8	3,325,908	53.6	1,767,868	8.00
South Carolina.....	209,212	17.1	3,564,592	61.9	2,226,572	10.75
Georgia.....	291,986	15.3	4,500,511	60.3	2,755,622	9.33
Florida.....	31,196	13.5	421,248	64.5	273,872	8.82
Alabama.....	225,032	15.6	3,509,503	57.6	2,038,473	9.05
Mississippi.....	116,685	16.7	1,914,119	56.2	1,081,705	9.38
Kentucky.....	239,696	21.0	5,053,044	41.6	2,000,321	8.60
Tennessee.....	188,094	19.4	3,588,663	43.7	1,557,242	8.54
Arkansas.....	215,173	20.0	4,278,428	47.0	1,948,183	9.34
Louisiana.....	31,042	16.9	523,677	51.2	268,463	8.65
Oklahoma <i>a</i> .....	480,303	29.4	13,872,095	37.7	5,202,283	10.58
Texas.....	798,442	27.8	22,712,303	48.2	10,242,235	12.71
Average for total area.....	3,401,623	21.8	74,041,090	46.4	34,329,281	10.09

*a* The figures for Oklahoma are for nine years, 1901-1909, inclusive, and include Indian Territory previous to its admission as a State.

Table I shows that Texas and Oklahoma were the leading States in acreage, production, total value, and in yield to the acre. These two States produced nearly as many bushels of oats as all the other Southern States together. Kentucky, Georgia, and Arkansas each produced more than 4,000,000 bushels annually, while most of the other States ranged from 2,000,000 to 3,500,000 bushels each. Virginia, North Carolina, South Carolina, Alabama, Kentucky, Tennessee, and Arkansas each devoted about 200,000 acres annually to this crop, while Georgia grew oats on nearly 300,000 acres. The average yield to the acre in most of the States was below 20 bushels; in North Carolina and Florida it was less than 15 bushels. The price per bushel was high in most of the States, ranging from 38 to 45 cents in the northern portion of the area and from 50 to 65 cents in the southern part. In some of the States where the yield fell below 20 bushels the

acre value was as high as in some of the Northern States where the average yield was 30 bushels to the acre.

The acreage and acre value of oats, corn, and wheat in each of the Southern States for the ten years 1900–1909, inclusive, are shown in Table II.

TABLE II.—*The average acreage and acre value of oats, corn, and wheat in the Southern States for the ten years 1900–1909.*

State.	Acreage.			Value per acre.		
	Oats.	Corn.	Wheat.	Oats.	Corn.	Wheat.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>			
Delaware.....	5,554	193,450	111,762	\$10.96	\$14.64	\$13.59
Maryland.....	38,778	637,704	781,849	10.32	17.34	13.57
Virginia.....	209,237	1,867,272	754,172	7.93	13.51	9.62
West Virginia.....	94,735	765,775	378,196	9.91	17.33	10.34
North Carolina.....	226,458	2,689,974	605,243	8.00	10.23	8.33
South Carolina.....	209,212	1,910,032	296,181	10.75	8.99	9.37
Georgia.....	291,986	4,077,388	320,093	9.33	8.48	9.28
Florida.....	31,196	611,961	.....	8.82	7.59	.....
Alabama.....	225,032	2,874,325	103,888	9.05	9.29	9.87
Mississippi.....	116,685	2,100,916	2,598	9.38	10.15	9.42
Kentucky.....	239,696	3,213,352	804,941	8.60	13.53	9.94
Tennessee.....	188,094	3,194,754	927,750	8.54	12.49	8.72
Arkansas.....	215,173	2,406,448	220,315	9.34	10.59	8.15
Louisiana.....	31,042	1,532,515	.....	8.65	10.10	.....
Oklahoma.....	480,303	3,980,448	1,441,832	10.58	9.95	9.16
Texas.....	798,442	6,400,478	989,875	12.71	10.73	9.34
Average for total area.....	3,401,623	38,456,792	7,738,695	10.09	11.02	9.70

Table II shows that the average acreage of corn in the Southern States for the ten years 1900–1909, inclusive, 38,456,792 acres, was about eleven times that of oats, while the average acreage of wheat, 7,738,695 acres, was more than double that of oats. The corn acreage in each of the States was usually from ten to twelve times that of oats. In four of the States, Alabama, Mississippi, Florida, and Louisiana, the oats acreage exceeded the wheat acreage, while in Georgia and Arkansas it was but little smaller. In Texas, Oklahoma, Delaware, Maryland, and South Carolina the acre value was more than \$10. In South Carolina, Georgia, Oklahoma, and Texas the acre value was greater than that of either wheat or corn; it was greater than that of corn in Florida and greater than that of wheat in Arkansas. No figures were reported for wheat in Florida and Louisiana.

#### VALUE OF A WINTER GRAIN CROP IN THE SOUTH.

Farm conditions in the South can be improved by the use of a greater variety of crops and of definite systems of crop rotation and by the keeping of a greater number of live stock. A rational crop rotation in the South is one which occupies the land practically the entire year, protecting the soil from washing during the winter by the use of a growing crop, such as crimson clover, vetch, or winter

grain. Increasing the number of live stock requires the production of more grain for feeding. Winter grains combine the two essential features, grain production and soil cover, in one crop. Within reasonable limits they supply a third desirable feature, winter pasture. On the other hand, spring-grain production in the greater portion of the Southern States is far from certain. Winter varieties of wheat and barley have almost entirely replaced the spring types of these grains, so that the only spring-grain crop now generally sown in the South is oats.

### FALL-SOWN COMPARED WITH SPRING-SOWN OATS.

The advantages of fall seeding of oats over spring seeding wherever the winter varieties can be grown are numerous. The yields are usually better, the fall-sown oats mature earlier, the land can usually be prepared in better shape in the fall than in the spring, fall seeding interferes less with other work than does spring seeding, poorer land and less fertilizer can be used for the fall-sown crop, and the fall-sown crop furnishes a cover for the soil during the winter and prevents washing.

Winter oats almost invariably yield more than spring oats, owing to their earlier maturity, stronger growth, and greater freedom from disease. If a part of the stand is lost from winterkilling, the plants which are left stool vigorously, so that the stand at harvest is much better than was apparent in early spring. Fall-sown oats usually grow more vigorously and mature from ten days to two weeks earlier than those sown in the spring. This earlier maturity often marks the difference between success and failure, as the later maturing grain is more likely to be injured by storms or drought and by rust and other plant diseases. Oats require comparatively cool weather for their best growth, so that those which mature earliest usually yield best, as the conditions are better suited to their development. The early maturity incident to fall seeding also allows the crop to be removed from the land earlier than spring seeding, giving more time for the preparation of the soil, seeding, and the growth of the following crop.

In a seven-year test at the Alabama Agricultural Experiment Station, in which November and February seedings were compared, the fall-sown oats yielded 26.8 bushels to the acre, while the spring-sown yielded only 15.5 bushels. The gain in favor of November seeding was 11.3 bushels, or 73 per cent of the spring-sown crop. The spring-sown oats outyielded the fall-sown in only one year of the seven, when 25 per cent of the fall-sown crop winterkilled. At the Arkansas station three varieties of fall-sown oats yielded 75 per cent more than the average of twenty spring-sown varieties. The best-yielding

varieties of fall-sown oats yielded more than 40 bushels to the acre, as compared with more than 30 bushels for the best of the spring-sown kinds. At the Virginia station, in a two-year test, fall-sown Culberson oats yielded 27.8 bushels to the acre, while the best of the spring varieties—the Silvermine—yielded 27.2 bushels. Better yields have



FIG. 1.—Heads of three varieties of winter oats. A, Winter Turf; B, Culberson; C, Red Rustproof.

also been secured at the Georgia station and at the Edgecombe (North Carolina) branch station from fall than from spring seeding.

In order to obtain a satisfactory crop of spring oats it is necessary in the extreme South to sow the grain in January or early in February, and in February or early March farther north. At this time the ground is usually wet and cold and is not in condition to make a



good seed bed. Clay soils may be materially injured by working them when wet, and only very sandy ones can be handled satisfactorily in this condition. On the other hand, at the time when the grain should be sown in the fall the ground is ordinarily in good condition to work, and a good, mellow seed bed can be prepared. This better preparation starts the young plants into vigorous growth and they go into winter in good shape. Seed sown in the winter or early spring on poorly prepared land is handicapped by this poor preparation, grows slowly, and is never as vigorous as that sown in a good seed bed.

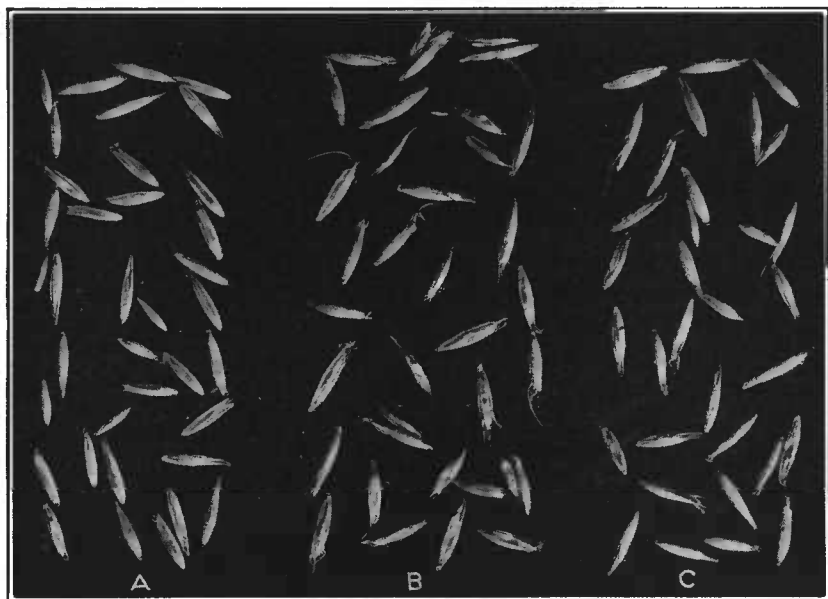


FIG. 2.—Grains of three varieties of winter oats. A, Winter Turf; B, Culberson; C, Red Rustproof.

When weather and soil conditions are right for preparing land in the spring, teams and men are needed to get the land ready for the more important crops, corn and cotton; consequently the preparation of the land for sowing oats is hurried or neglected. Fall seeding comes at a time when the teams are not needed for other work, and there is more time to do the work properly. It allows a better division of the farm work, so that more time can be given to preparing the land in the spring for other crops. If the fall-sown crop of oats fails, little additional work is necessary to put the land in shape for reseeding in the spring.

As the plants have a longer time to draw the plant food from the soil, and as they naturally grow more vigorously, fall-sown oats

can be grown on poorer ground and with less fertilizer than those sown in the spring. Good soil and proper fertilization have much to do with the success of the oat crop in the South, however, regardless of the time of seeding.

One of the greatest losses on southern farms is from the washing of the soil during the winter. This can best be prevented by growing a crop on the land. Winter oats make a close, dense cover, which is very effective in holding the surface soil to prevent washing.

The foregoing are some of the reasons why it is desirable to sow oats in the fall in the South wherever there is a reasonable chance that they will withstand the winter. It is believed that proper

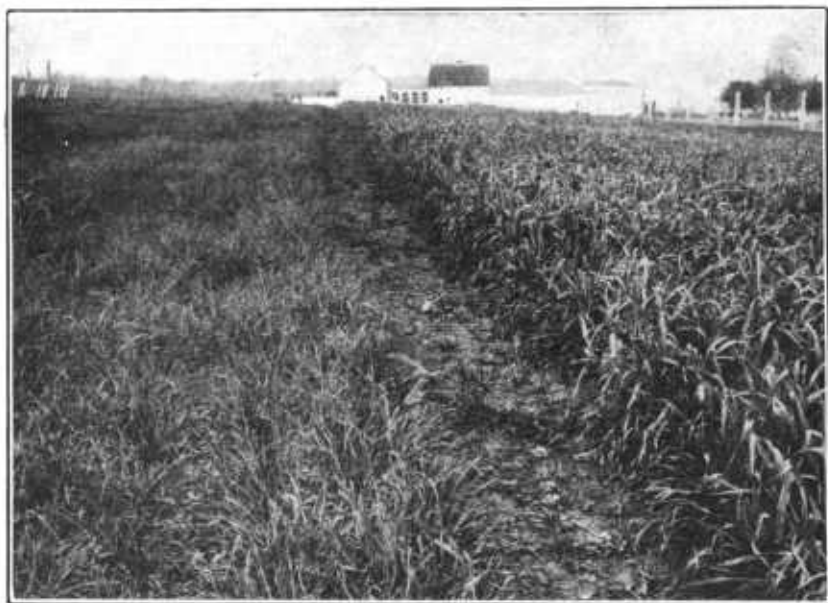


FIG. 3.—Plats of winter oats in November at the Maryland Agricultural Experiment Station, College Park, Md. Note the broad leaves and erect habit of the Red Rustproof variety (on the right) in contrast with the narrow leaves and spreading habit of the Winter Turf (on the left).

methods of soil preparation and of seeding, and the use of plump, heavy seed of hardy, productive varieties, will largely increase the production of this grain. The methods described in this bulletin are in use by the agricultural experiment stations and by good farmers.

#### VARIETIES OF WINTER OATS.

The varieties of winter oats commonly grown in the South are of one or the other of two types, the Red Rustproof and the Winter Turf. The Red Rustproof type includes the common Red Rustproof under several similar names and several selections and strains of that

variety under entirely different names. Only one variety of the Winter Turf type is commonly grown, though many names are applied to it.

Red Rustproof is the typical variety of the group to which that name is here applied. Among the other names used for the same variety are Red, Texas Red, Red Texas, and Texas Red Rustproof. The leaves of the young plant in the fall are medium green in color and rather broad. The plant, while spreading, is less so than most other winter grains. The straw of this variety is of medium height, straight and stiff. The heads are not large, but numerous. The grains are large and plump, yellowish or reddish brown in color, and usually all awned. The Red Rustproof is early in maturing and is

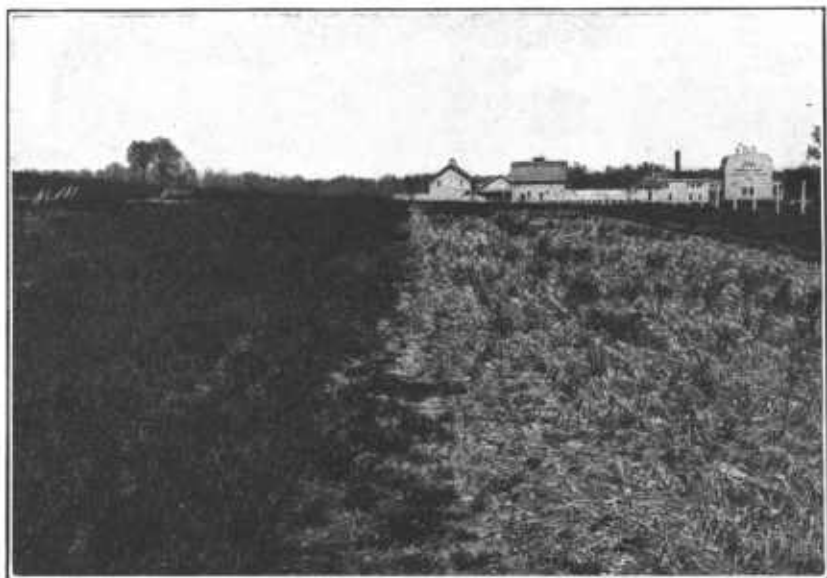


FIG. 4.—The same plats shown in Fig. 3, photographed the following spring, showing the winterkilling of the Red Rustproof in contrast with the survival of the Winter Turf variety.

quite free from rust. As commonly grown in the South, this variety contains a small percentage of black kernels which produce plants maturing earlier than the type. When grown by itself this black strain yields much less than the pure Red Rustproof. Seed of the Red Rustproof also usually contains some medium-sized white kernels, producing strong plants and large heads which mature at about the same time as those from the red grains. The Culberson variety, as it is commonly grown, appears to be a selection of this white type, though occasionally oats sold under this name can not be distinguished from the common Red Rustproof. The Culberson oat yields as much grain as the Red Rustproof, produces more straw, and is a better

variety to grow for hay or soiling. The Appler is a strain of Red Rustproof selected by Mr. J. E. Appler, of Georgia, a number of years ago. All the varieties of this type may be sown either in the fall or spring.

The Winter Turf oat, which is also called Virginia Gray, Virginia Winter, Grazing, and several similar names, is better adapted to pasture and hay than to grain production. The leaves are narrow, dark green in color, and numerous; the plant is more spreading in the fall than that of the Red Rustproof variety. The straw is tall and slender and the heads large and loose. The grain is of medium size, usually light gray in color, bearded or beardless; the beards, when they do occur, break off readily in thrashing. This variety is not resistant to rust or lodging. The numerous names applied to it



FIG. 5.—Plats of the Winter Turf (on the right) and the Culberson (on the left) varieties of oats at the Maryland Agricultural Experiment Station, College Park, Md., on March 20, showing the difference in winter survival.

may sometimes denote distinct strains, which, however, differ but little from the type. The Dun and the Oregon Gray Winter varieties are very similar to the Winter Turf. Heads of the Red Rustproof, Culberson, and Winter Turf varieties are shown in figure 1, while grains of these varieties are shown in figure 2.

Among the other varieties which are occasionally sown in the fall is the Burt, sometimes called the Ninety-Day or May. This variety is quite similar to Red Rustproof, but is less hardy. It is ordinarily sown in the spring, as it usually does well from spring seeding. In Utah a black oat, known locally as Boswell Winter, is grown to some

extent on the dry farms. Black Winter oats are also grown in Oregon and Washington. The oats commonly grown in California are Red Rustproof.

The varieties of the Red Rustproof type are best adapted to the production of grain in all except the coldest portions of the winter-oat belt, where Winter Turf is to be preferred on account of its greater hardiness. In the sections where Red Rustproof is sufficiently hardy, the Winter Turf is rather too late in maturing and is often injured by hot weather, producing low yields of poor quality. For pasture and hay production Winter Turf is better than either Red Rustproof or Culberson. Figure 3 shows the differences in the fall growth of the Winter Turf and the Red Rustproof, while figure

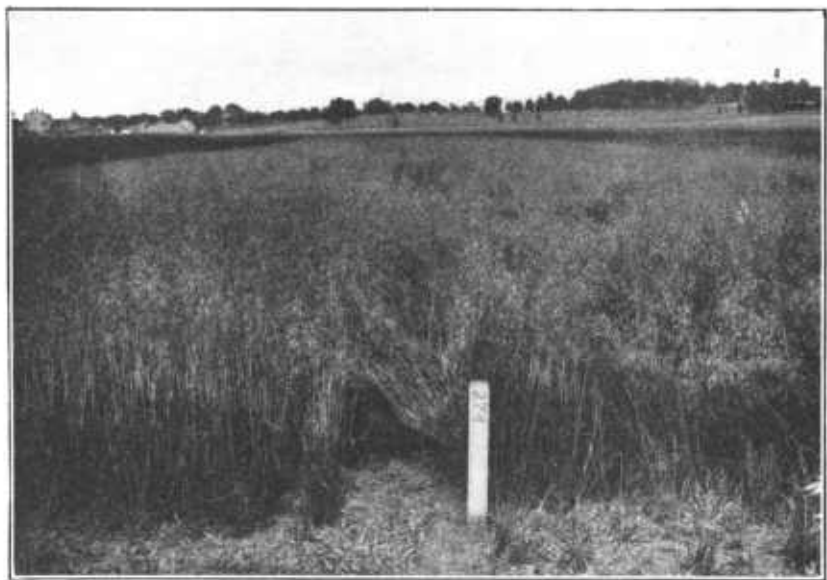


FIG. 6.—Plats of Winter Turf and Culberson oats shown in Fig. 5, at harvest time. Note the manner in which the Culberson variety (on the left) has stooled, forming a good stand; also its erect habit in contrast with the tendency to lodge shown by the Winter Turf oats.

4 shows the relative hardiness of these two varieties following a severe winter. Figures 5 and 6 show comparative stands of Culberson and Winter Turf in early spring and at harvest time.

### SECTIONS WHERE WINTER OATS CAN BE GROWN.

No definite limits can be drawn marking the sections where winter oats can or can not be grown. The variety, the method of preparation, the time and manner of seeding, the kind of land on which the crop is grown, and the climatic conditions of the particular section must all be taken into account. Varieties of the Winter Turf type can

be grown in colder sections than those of the Red Rustproof type. Oats sown early in drills or furrows on well-prepared land often survive the winter in the same locality where those sown under less favorable conditions winterkill. Winter oats may be successfully grown in a particular section for several years; a season may then come when the crop will be entirely destroyed by cold or other unfavorable conditions.

The accompanying map (fig. 7) shows approximately the sections in which winter oats can be grown with a reasonable degree of success. The crop is recommended for South Carolina, Georgia, Alabama, Florida, Mississippi, and Louisiana; Virginia and North

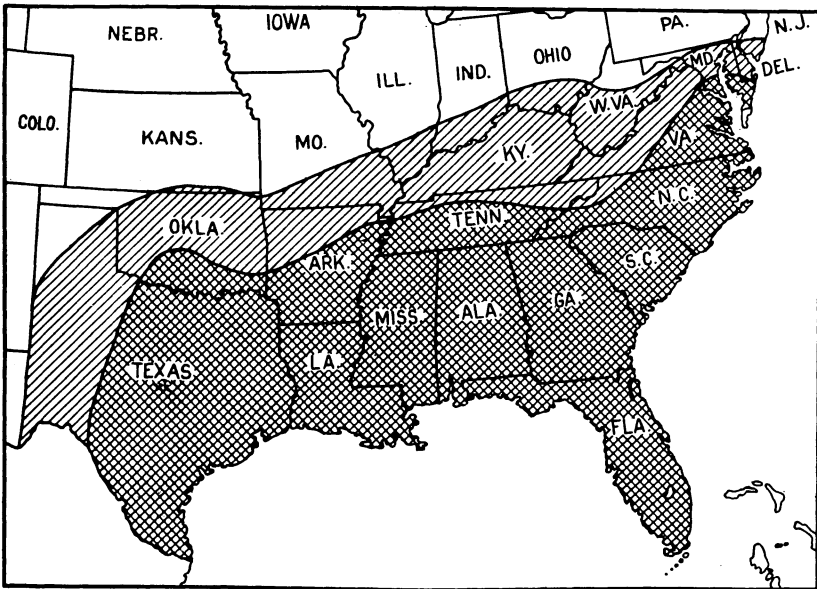


FIG. 7.—Map of the southeastern portion of the United States, showing area to which winter oats are adapted. The heavily shaded portion shows the section where they are a comparatively sure crop; the section where they are worthy of trial is shown by lighter shading.

Carolina, except the highest mountain sections; the lower portions of Maryland, Tennessee, and Arkansas; and for eastern, central, and southern Texas. It is worthy of trial in southern Delaware, in favorable locations in West Virginia and Kentucky, in northern Arkansas, and in Oklahoma and the portions of Texas not previously mentioned. Winter oats are also grown to a limited extent in Utah, Oregon, and Washington. In California and in some portions of Arizona and New Mexico oats are sown in the late fall or early winter. Winter oats have also been grown with success experimentally in Connecticut, Ohio, and southern Michigan, but can not yet be recommended for these or similar localities. It is probable that the

winter-oat area will gradually extend northward, but the spring-sown crop is not likely to be displaced in the corn belt. The discussion of the crop in this bulletin is confined to the Southern States.

## SOILS AND FERTILIZERS FOR OATS.

### SOILS ADAPTED TO OAT PRODUCTION.

As quick growth and early maturity are essential to the success of the oat crop in the South, the soils and fertilizers which will produce these results should be selected.

The soil for oats should be reasonably fertile and should hold moisture well, as this crop requires a large amount of water and may be severely injured by drought. Any soil which will grow a good crop of cotton or corn will produce oats, though the best results will be secured on the heavier loams. Heaving, or the "spewing out" of the plants, is most likely to occur on clay soils, particularly on those deficient in humus. A well-fertilized sandy or sandy-loam soil will generally prove more satisfactory, particularly if it is well filled with humus, so that its moisture-holding capacity is high. Good drainage is essential, however, as winterkilling is most likely to occur on poorly drained land. Rust and other diseases are also most severe on low, poorly drained areas. As the varieties of oats commonly grown in the South, with the exception of the Winter Turf, have short, stiff straw, they are less likely to lodge on rich soil than those grown in the North.

### MANURES AND COMMERCIAL FERTILIZERS.<sup>a</sup>

A good crop of oats removes nearly as much nitrogen, phosphoric acid, and potash from the soil as a good crop of corn. Nitrogen (ammonia) can be supplied in nitrate of soda, dried blood, cottonseed meal, or other commercial forms, or by growing a leguminous crop, such as cowpeas, soy beans, or clover. Potash is usually applied in the form of the muriate, and phosphoric acid in acid phosphate. The quantity of all the fertilizing materials needed, of course, depends largely on the nature and the fertility of the soil. Barnyard manure is not usually available in sufficient quantity to be much of a factor in keeping up the fertility of the soil.

#### Green Manures.

The best and cheapest method of adding nitrogen is by growing a green-manure crop, which gathers nitrogen from the air and stores

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<sup>a</sup> An extended discussion of fertilizers, with tables showing the best quantities of the various materials to apply for oats and for other crops on the different soils of the South, is contained in Farmers' Bulletin 398, entitled "Farm Practice in the Use of Commercial Fertilizers in the South Atlantic States."

it in the soil. Green manures also supply humus or vegetable matter, which is usually lacking in southern soils. The crop most commonly used for this purpose in the South is cowpeas, though crimson clover, vetch, velvet beans, bur clover, peanuts, and red clover are among the others which are available. Cowpeas and soy beans are among the best available crops to immediately precede oats. Velvet beans are also excellent, but can not be grown profitably except in the Atlantic and Gulf coastal plain regions from South Carolina southward. These crops may be cut for hay, turning under only the stubble and roots, or the entire crop may be used as green manure. The fertilizing effect on the following crop is about the same whether the stubble or the entire plant is turned under, but the vines add considerable humus and improve the physical condition of the soil. If the vines are turned under, the land should be plowed three or four weeks before the oats are to be sown, as the ground should have time to settle before seeding. If the oats must be sown at once after the land is prepared, it is better to harvest the vines and disk the land thoroughly instead of plowing it.

#### **Barnyard Manure.**

Barnyard manure is an excellent fertilizer for almost all crops, as it contains all the elements of plant food and a considerable quantity of humus as well. One of the best methods of using barnyard manure on oats in the South, where it is seldom available in large quantities, is as a top-dressing applied in the late fall or early winter. When so applied it serves as a protection to the crop during the winter and at the same time adds fertility to the soil. It is probable that the largest increase to the ton of manure will result from the application of about 5 tons to the acre.

#### **Commercial Fertilizers.**

If nitrogen has been supplied in liberal quantities through the growth of legumes as green manures, it need not be added in commercial fertilizers. If, however, a green-manure crop does not immediately precede the oats, or if the preceding crop was light, some readily available fertilizer carrying nitrogen (ammonia) should be used. The best results on most classes of soil are to be obtained by adding this nitrogen as a top-dressing in the spring, about two months before harvest. The nitrate should be sown broadcast and worked into the soil with a harrow. Cottonseed meal or dried blood may be used to supplement the nitrate of soda. On sandy soils the application of about 25 pounds of nitrogen (50 pounds of nitrate of soda and 200 pounds of cottonseed meal or 100 pounds of dried blood) to the acre is recommended.



On clay soils this may be reduced to 18 or 20 pounds of nitrogen (30 pounds of nitrate of soda and about 150 pounds of cottonseed meal). If the oats are grown for hay, more nitrogen should be used than when they are grown for grain. A much larger increase in yield of grain per hundred pounds of nitrate of soda applied was obtained at the Alabama station from the use of 100 pounds or less to the acre than from 200 pounds, though 200 pounds gave a greater total yield than 100 pounds. A bulletin of this station states that a profit of from \$4 to \$6 can be expected from the application of 60 to 100 pounds of nitrate of soda to fall-sown oats. Cottonseed meal is recommended as being a better fertilizer for oats than cotton seed.

If the soil has been liberally fertilized for other crops, phosphoric acid and potash need not be added for oats. Usually, however, increased yields result from light applications of acid phosphate and muriate of potash at the time of seeding. The proper quantity of acid phosphate to apply varies from 100 to 125 pounds to the acre on fertile clay soils to 200 to 250 pounds on the poorer sandy soils. The rate for muriate of potash varies from 30 pounds on the better clay soils to 60 pounds on poor sandy ones. Nitrogen, however, is usually the limiting element in the production of oats on southern soils.

The Georgia station recommends the application of 200 pounds of acid phosphate, 50 pounds of muriate of potash, 25 pounds of nitrate of soda, and 200 pounds of cottonseed meal when the grain is sown, and of 75 pounds of nitrate of soda in the spring. Where cowpeas or similar crops have been grown the nitrate of soda and cottonseed meal to be applied in the fall may be omitted, making the application 200 pounds of acid phosphate and 50 pounds of muriate of potash in the fall and 75 pounds of nitrate of soda in the spring. This quantity may be somewhat increased for poor sandy land and decreased for fertile loam and clay soils. On the heavy "black waxy" soil of Texas it is probable that both the phosphate and potash may be omitted, and only the nitrate of soda added in the spring. On this soil the use of barnyard and green manures to supply humus is particularly to be recommended.

#### LIMING THE SOIL.

Liming is not usually beneficial to oats, but may be of value in correcting the acidity of sour soils, particularly where heavy green-manure crops have been plowed under. Lime is most beneficial to the growth of clover, alfalfa, and other legumes, so that the best results are usually obtained when it is added before growing one of these crops. The application of from 25 to 40 bushels of lime or

from 1 to 2 tons of finely ground limestone to the acre is usually sufficient to correct the acidity of the soil for five years or more. Where heavy green-manure crops are plowed under every year, more frequent applications of lime may be necessary.

### WINTER OATS IN THE ROTATION.

Oats should follow a cultivated crop wherever possible. The most common cultivated crops in the South are cotton and corn, and, as corn is removed from the land earlier than cotton, oats usually follow the former. One of the best rotations which can be devised for the cotton-growing section is as follows: First year, cotton; second year, corn, with cowpeas planted at the last cultivation; third year, winter oats, followed by cowpeas.

This rotation is strongly recommended by the Georgia station. The corn is cut for fodder, instead of being stripped and topped, as is commonly done in some sections; the corn stubble and cowpea vines are then turned under in time to sow oats in the fall. As the growth of pea vines is not heavy, the plowing can be done a short time before seeding. After the oat crop is removed the third year, the land is plowed and planted to cowpeas, which are cut for hay. If desired, crimson clover may be sown in the cotton the first year and plowed under in the spring before corn-planting time. Rye may also be sown the third year after the cowpeas and plowed under for cotton, thus providing a cover for the soil each winter. This rotation gives two grain crops, corn and oats; a money crop, cotton; a hay crop, cowpeas; and three green-manure crops, crimson clover, cowpeas planted in the corn, and rye, in three years. Two crops of cotton may be grown in this rotation, if desired, making a four-year rotation.

Outside the cotton-growing section a good rotation, including oats, is as follows: First year, corn, with cowpeas in the corn; second year, oats, with clover or grass seeded in the oats; third year, meadow or pasture.

If it is desired to grow wheat, oats may be sown after the corn and cowpeas planted after the oats are harvested. Wheat may then be planted after the cowpeas and grass seeded with it. Potatoes or other cultivated crops may be substituted for corn if desired. Where clover does not succeed, or where a permanent meadow is not wanted, the following rotation is a good one: First year, corn, with cowpeas in the corn; second year, wheat, followed by cowpeas, which are cut for hay; third year, oats, followed by cowpeas, sorghum, or some other forage crop.

If desired, rye may be sown after the forage crop is harvested, or the forage crop may be omitted and crimson clover sown early in the fall. The rye or crimson clover is then plowed under the following spring for corn. Other rotations along similar lines can be arranged, according to the crops it is desired to grow.

The value of a leguminous crop preceding oats is well shown by experiments at the Alabama station. The yield after corn was 13.7 bushels to the acre; after cowpeas plowed under, 19.9 bushels; and after peanuts from which the nuts had been picked, 30 bushels. In another experiment the yield after millet was 9.7 bushels; after crab-grass and weeds, 7.1 bushels; after velvet beans, stubble only, 38.7 bushels; after velvet beans, vines plowed under, 28.6 bushels; after cowpeas, stubble only, 34.4 bushels; and after cowpeas, vines plowed under, 28.8 bushels. The average yield after nonleguminous plants was 8.4 bushels, while after leguminous plants it was 32.6 bushels, with a corresponding difference in the yield of straw. These figures, however, are the results of only one year's work. A large part of the benefit could, no doubt, have been secured by growing oats after a cultivated crop in a short rotation which included two or more leguminous crops.

#### PREPARATION OF THE LAND FOR OATS.

The method of preparation of the land depends to some extent on the previous treatment it has received and on the character of the soil. In any case a loose, mellow seed bed should be prepared, as the success of the crop depends in a large measure on the condition of the seed bed and on the fall growth.

In general, the land should be plowed 5 or 6 inches deep at least a month before the oats are to be sown, and the plow followed immediately by the spike-tooth or other smoothing harrow. Double disking and another harrowing should then put it in shape for drilling. Additional disking and harrowing may be necessary, if the ground is hard and rough. If it is loose from recent plowing, the roller or plank drag may be used to make a more compact seed bed. Rolling may often be done to advantage on loose, sandy land, but on the heavier loam and clay soils the roller should always be followed with the harrow to break the crust and check evaporation. If the land has been thoroughly plowed the preceding spring for some other crop and has been thoroughly cultivated throughout the season, disking and harrowing may take the place of plowing, especially on sandy land. The fertilizer may be distributed when the seed is sown if the oats are to be drilled; otherwise, it should be applied before the last harrowing.

## PREPARATION OF THE SEED.

### CLEANING AND GRADING THE SEED.

The yield of oats can be considerably increased by cleaning and grading the seed and by treating it to prevent smut.

Seed oats should be thoroughly cleaned and graded before sowing. The stand produced from heavy seed is better and more uniform than that from ungraded seed. The strong, vigorous plants produced from plump, heavy seed stand the winter better than the weak ones which grow from light shriveled grains; their growth is better throughout the season and the yield larger. Cleaning the seed not only removes the weak, light grains of oats but takes out many weed seeds. Most of the seeds of cheat or chess, one of the most troublesome weeds in oat fields, can be removed by thorough cleaning.

Seed oats are usually cleaned and graded with the fanning mill, but where this machine is not available and the quantity of seed sown is small, fairly effective work can be done by pouring the grain back and forth from one vessel to another in a brisk wind. If a considerable quantity of seed is to be cleaned, the gain from sowing cleaned seed will soon repay the cost of a fanning mill.

### TREATMENT OF SEED FOR SMUT.

A considerable portion of the oat crop is lost each year from the attacks of the smut fungus. This loss is easily and cheaply prevented by treating the seed before sowing with a solution of 1 pound of formalin to 40 gallons of water.<sup>a</sup>

The grain should be placed on a clean floor or canvas and sprinkled with the solution. The pile should be shoveled over occasionally while applying the formalin, to make sure that all the grain is thoroughly moistened. It should then be covered with blankets or canvas and left for several hours, when it may be sown at once or spread out to dry. It will run through the drill much better if dried before sowing. Grain may also be treated by pouring it into a tub of the solution, stirring thoroughly, and spreading out to dry after it has remained in the solution twenty or thirty minutes. Sprinkling is just as effective, however, and is a cheaper and more rapid method. Care should be used not to put the treated grain into bins, sacks, or machinery where it is likely to come in contact with smut spores.

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<sup>a</sup> Farmers' Bulletin 250, entitled "The Prevention of Stinking Smut of Wheat and Loose Smut of Oats," gives complete directions for the use of the formalin treatment.

### SOWING THE SEED.

The success of the winter-oat crop depends in a large measure on the time, the rate, and the manner of seeding. Early seeding with the grain drill or in open furrows, using 2 bushels of seed to the acre, is recommended.

#### TIME OF SEEDING.

Winter oats are less hardy than winter wheat or barley and for that reason should be sown earlier, so that the plants may become well rooted and make considerable top growth before cold weather. Oats are seldom attacked by insects in the fall, so that there is no necessity for delay in seeding, as with wheat where the Hessian fly is common. In the extreme South, seeding need not be done until November, but farther north September and October are the best months.

In Oklahoma, northern Arkansas, Kentucky, Tennessee, Maryland, and the higher portions of Virginia and North Carolina seeding should usually be completed by September 20. The Virginia station secured an average yield of 30.64 bushels to the acre in a four-year test from Culberson oats sown September 15, 28.06 bushels from those sown September 30, and 15.32 bushels from the seeding of October 15, while in three of the four years the plats sown October 30 were a total failure. At the Maryland station better yields were obtained from seeding September 1 than two or four weeks later.

In the lower portions of Tennessee, Virginia, and North Carolina, the mountain sections of South Carolina, Georgia, and Alabama, southern Arkansas, and in northern Mississippi and Texas, the seed should ordinarily be sown between September 20 and October 10. In northern Louisiana, central Texas, Mississippi, Alabama, and Georgia, and the lower portion of South Carolina seeding may be done almost any time during the month of October, while along the Gulf coast late October and early November seeding is usually satisfactory. Time-of-seeding tests have not been reported in recent years from any of the Southern States except Virginia. October seeding in Georgia and Alabama is advised, however, by the agricultural experiment stations in those States.

#### METHOD OF SEEDING.

The methods of seeding winter oats are (1) broadcast seeding; (2) drilling with the ordinary grain drill; and (3) drilling with a specially devised drill by what is known as the open-furrow method.

##### Broadcast Seeding.

Winter oats are sometimes sown broadcast, but this method is not to be recommended. When sown broadcast and harrowed in, much

of the seed is left near the surface, even in well-prepared ground, so that many of the plants are shallow rooted and are killed by heaving or cold. A better method, where broadcast seeding is necessary, is to sow the seed on clean ground which has been disked, covering it about 3 inches deep with the turning plow. The ground should then be left rather rough, as the uneven surface furnishes some protection for the plants. More seed should be used in broadcast seeding than in drilling.

#### Drilling the Seed.

The use of the grain drill in sowing winter oats is strongly recommended. Drilling produces a more uniform stand and more even germination and growth than broadcast seeding. Drilling also re-



FIG. 8.—A disk drill with drag chains removed, as it should be used in sowing winter oats.

quires less seed and the plants are less likely to winterkill. Drilling at least 3 inches deep on well-prepared land, leaving the drill furrows as open as possible, is advised. Drag chains should not be used on the drill, nor should the land be harrowed after drilling. This leaves the seed in the bottom of shallow furrows, which in a measure protect the young plants from winterkilling. Figure 8 shows a disk drill as it should be used in sowing winter oats.

As the grains of varieties of the Red Rustproof type are likely to stick together, the drill should be watched closely to see that the seed is being evenly distributed. A drill with a good force feed will sow this variety quite satisfactorily.

### The Open-Furrow Method of Seeding.

The Georgia experiment station a number of years ago devised what is known as the open-furrow method of seeding oats. By this method the seed is sown in drills from 16 to 24 inches apart, the ordinary single-row planter or a specially devised drill being used for the purpose. If desired, a drill with a fertilizer attachment may be used and the fertilizer distributed in the furrows with the seed. A combined grain and fertilizer drill, for sowing 4 rows 16 inches apart by the open-furrow method, is shown in figure 9.

The seed is sown in drills or furrows several inches deep, so that the roots and crowns of the plants are 2 or 3 inches below the surface. The rains and alternate freezing and thawing partially fill these furrows, but the plants are still left well below the surface. Run-

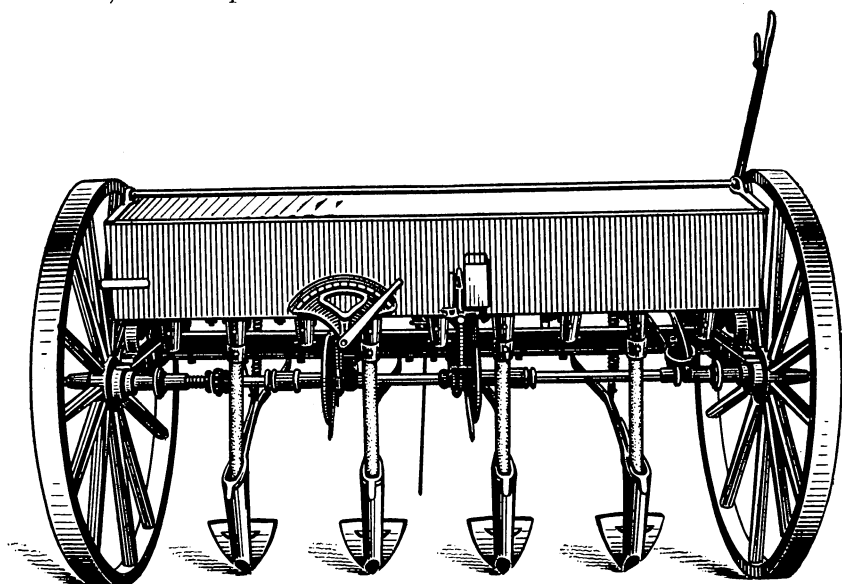


FIG. 9.—Open-furrow drill for sowing winter oats.

ning the drills across the usual direction of the winter winds is recommended by the Georgia station as an additional protection, as the slight wall of earth prevents the full force of the wind from striking the plants. Thus, if the coldest winter winds are ordinarily from the northwest, the drills should run northeast and southwest.

In a four-year test at the Alabama station the open-furrow method of seeding was compared with broadcast seeding. The average yield for the broadcast plats was 24.2 bushels to the acre, while the plats drilled in deep furrows yielded 27.4 bushels. Drilled plats in which the furrows were filled after seeding averaged 26.7 bushels. This station recommends the open-furrow method on well-drained land; on wet or very level land water may stand in the furrows long enough to injure the crop.

### RATE OF SEEDING.

The rate of seeding usually recommended for Red Rustproof and similar varieties of oats when sown with the open-furrow drill is 2 bushels to the acre. When sown with the ordinary drill  $2\frac{1}{2}$  bushels is about the proper rate. Broadcast seeding requires still more seed, from 3 to 4 bushels being necessary. As the Winter Turf oat is somewhat hardier and stools more than the Red Rustproof, it may be seeded at a lower rate, from  $1\frac{1}{2}$  to 2 bushels when drilled or  $2\frac{1}{2}$  bushels when sown broadcast. In the northern portion of the winter-oat area, where the danger from winterkilling is great, and farther south when late seeding is necessary, the rate of seeding should be somewhat increased.

From  $2\frac{1}{2}$  to 3 bushels of the Red Rustproof or Culberson and 2 to  $2\frac{1}{2}$  bushels of the Winter Turf are about the proper rates of seeding for the colder portions of the winter-oat belt. When the crop is to be used for pasture or hay somewhat heavier seeding is advisable than where it is grown for grain. When used as a nurse crop for grasses or clover, or when grown with crimson clover or vetch, less seed should be used than when oats are grown alone.

### TREATMENT OF THE LAND AFTER SEEDING.

Top dressing with barnyard manure in the fall and the application of nitrate of soda in the spring have already been discussed as means of increasing the yield of fall-sown oats. Injury to the plants from heaving during the winter and early spring, with the consequent exposure of the roots to the sun and wind, may sometimes be prevented by rolling the land as soon as possible after the heaving takes place. Clay soils, the type on which heaving is most likely to occur, should not be rolled when wet, so that this method of reducing the damage can not always be used. Harrowing in the early spring will help to keep weeds in check and will also loosen the hard surface soil and prevent loss of moisture. When the open-furrow method of seeding is used the ridges between the rows should be leveled down in the spring with the harrow.

Winter oats, like other winter grains, are sometimes used as pasture for stock. Early seeding is particularly essential when the crop is to be pastured in the fall. Pasturing at this time always increases the danger from winterkilling, as it lessens the protection afforded by the leaves. Winter oats should not be pastured as closely as winter wheat or rye, as the oats are less hardy than the other grains. Pasturing in the spring delays maturity. As earliness is essential to the production of a good crop of oats the value of the



pasture does not usually make up for the loss in yield of grain. Winter-grain fields should never be pastured when the ground is wet, as the trampling injures the physical condition of the soil. Harrowing in the spring to loosen soil which has been packed by pasturing is beneficial to the crop.

### SPRING SEEDING OF WINTER OATS.

Even though all precautions are taken, the stand of winter oats may sometimes be destroyed by cold weather or the effects of alternate freezing and thawing. As a safeguard against total loss when this occurs, the Georgia station suggests that a small part of the land to be devoted to oats be left unseeded each fall. If the fall-sown oats survive the winter, this portion of the field is sown to Burt oats as early as possible in the spring. On the other hand, if the fall-sown oats winterkill, the large field is sown to Burt oats in the spring and the small one to the winter variety in order to get seed for sowing the following autumn. The Alabama station found that the hardiness and yield of Red Rustproof oats were not injured by sowing one year in the spring, so that this plan may be followed without danger of loss. The smaller portion of the field should be large enough to produce sufficient seed of the winter variety to sow the entire crop the following fall, if necessary. Enough seed of the Burt to sow the larger area and enough of the winter variety for the small one should be reserved each year until the danger of winterkilling is past.

### WEEDS.

One of the most common weeds in winter-oat fields is cheat, or chess. The popular belief that oats turn to cheat is due to the rapid, vigorous growth of this weed and the manner in which it occupies the ground where grain has winterkilled. Occasional plants of cheat, which would hardly be noticed in a good stand of oats, grow so vigorously and stool so abundantly when given plenty of space by the winterkilling of the oats as to give the impression that the entire crop has turned to cheat. When a considerable proportion of the crop is cheat, the best plan is to cut the oats and cheat together for hay before the seeds mature. If the oats are entirely killed the cheat should be plowed under and the land used for a cultivated crop. Other winter weeds, such as chickweed, shepherd's-purse, and peppergrass, sometimes cause trouble, but these are not often serious pests and can usually be kept in check by harrowing. Weeds which do not start growth until spring do not often cause trouble, as the growth of the crop is rapid at that season. Rotation of crops, good cultivation, and thorough cleaning of seed grain are strongly recommended as means of keeping weeds under control.

### HARVESTING THE CROP.

Oats are usually cut with a grain binder, but where the area is too small to justify the use of this machine, a mower or even a cradle may be used. If cut with the binder the grain should be allowed to stand until nearly ripe or until just after it passes out of the hard dough stage. The bundles or sheaves should be set up in round shocks of 10 or 12 bundles each, using 1 or 2 bundles for caps or covering with canvas shock covers. The bundles should be thoroughly dry when shocked and the shocks should be carefully built, so that the grain is exposed as little as possible to the weather. If it is necessary to cut the oats with a mower, they should not be as ripe as for binding, or there will be loss from shattering in handling. The oats usually grown in the South do not shatter readily, however. When cut with the mower the grain should be allowed to cure for a short time in the swath or windrow, and should then be placed in well-built cocks and, if possible, covered with canvas covers.

When the grain has cured in the shock, which will be in about ten days if the weather is good, it should be stacked or placed under cover. If a thrashing machine is available, it may be thrashed at once. In any case, it should be dry when stacked or stored, as it is likely to mold if at all damp. Grain which has been cut with the mower may be stacked as soon as cured, and may then be handled in the same manner as that which is bound. In either case, it may, with little loss, be fed to stock without thrashing, or it may be thrashed when thoroughly dry. If it is thrashed, the grower should see that all the grain is removed from the straw and that the separation of grain and chaff is complete. After thrashing, the grain should be stored in tight bins, where it is protected from the weather and from vermin. The straw should be run into the barn or carefully stacked, so that the loss from weathering will be slight.

If the crop is to be used for hay, it should be cut after the grain is developed but before the straw becomes tough and hard. If it is grown with vetch, crimson clover, or some other crop, the time at which it is cut will depend to some extent on the state of maturity of the crop with which it is grown. The hay should be cured in the windrow and cock, with as little exposure to rain as possible, and should be placed under cover or stacked as soon as it is cured. The curing of hay is sometimes difficult in the South, owing to frequent rains, and the best quality can be secured only by protecting the cocks from the weather by the use of canvas covers. If these are carefully stored when not in use, they will last for a number of years and will prove a good investment. Oats may be cut for soiling (feeding green) as soon as the heads begin to show, and cutting may continue until

the crop is nearly ripe. If cut in the early stages, the stubble will produce a fairly heavy second crop.

### YIELDS.

As previously stated, the oat yields of the Southern States are low, averaging from 15 to 25 bushels to the acre. It is safe to assume, however, that the yield of winter oats in these States is considerably higher than that of the combined fall-sown and spring-sown crop. The yield of winter oats at the Alabama station from 1897 to 1906 varied from 5.5 to 62.5 bushels to the acre, according to the variety and the season, with an average of about 30 bushels. The Georgia station reports yields as high as 65 bushels. In the black waxy belt in Texas the production of from 60 to 80 bushels to the acre is not uncommon in favorable years, while more than 100 bushels are sometimes produced.

### IMPROVEMENT OF THE CROP.

Thorough cleaning and grading of the seed each year insures the grower against the running out of the strain, which is so generally believed to occur; in fact, there will be a gradual improvement in the yield and quality of the crop. Good home-grown seed is always better and safer than that of unknown origin which can be secured on the market. Little is to be gained, and there is considerable chance of loss when seed oats are brought from distant points, unless the seed is known to be pure or of selected strains. Otherwise it may contain troublesome weeds, be low in germination, or of a strain which is not winter hardy.

The improvement of oats through the selection of individual plants or heads and the testing of these selected strains is interesting and valuable work for those who have the time and patience to devote to it.<sup>a</sup> The best heads should be selected from strong, vigorous plants growing under normal conditions. Those which stand along the edges of the field or in open spaces should not be selected, as their vigorous growth is due to especially favorable conditions. The selected heads should be thrashed separately by hand, and the seed from each planted in a row by itself. Those which appear to be most promising should be selected the following season for further testing; the remainder should be discarded. The seed from each of the selected rows is thrashed and planted, the best rows being again selected at harvest time for further testing and increase the next

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<sup>a</sup> The method of testing these strains is described in detail in Circular 30, Bureau of Plant Industry, U. S. Dept. of Agriculture, entitled "Improvement of the Oat Crop."

year. Those which appear to be most promising should be increased as rapidly as possible. If all the seed is used, enough for large fields can be grown from a single head in a few years.

### INSECTS AND DISEASES.

The insect which is most likely to cause damage in growing oats in the South is the spring grain-aphis,<sup>a</sup> or "green bug." As this insect usually appears on small areas and in limited numbers at first, it can best be kept in check by plowing under the grain on these areas or destroying it by other means. Though the hulls protect oats to some extent from weevils and grain moths which attack the grain in the bin, these insects sometimes do considerable damage. The two most effective means of combating them are fumigation of the grain in tight bins with carbon bisulphid and with hydrocyanic-acid gas.<sup>b</sup>

Rust and smut are the two diseases which are most likely to affect the oat crop seriously. Conditions in the South are usually favorable to the development of rust, which needs damp, warm weather. The best preventive measures are the planting of rust-resistant varieties (the Red Rustproof type) and sowing only on well-drained land. Drilling in wide rows which admit the light and air, and the use of fertilizers rich in phosphoric acid and potash, thus inducing early maturity, also aid in keeping rust in check. Oat smut can be controlled by the use of the formalin treatment already mentioned.

### FEEDING VALUE OF OATS.

The feeding value of oats largely depends on the proportion of kernel to hull, as the hull contains little digestible material and a large amount of crude fiber. A good sample of oats contains from 65 to 75 per cent of kernel. Well-matured samples of Red Rustproof and other winter oats grown in the South show as high a percentage of kernel and as high feeding value as good spring oats grown in the North. An average sample of oats contains about 89 per cent of dry matter, or practically the same as wheat, barley, and corn. One hundred pounds of oats, according to Henry,<sup>c</sup> contain 9.2 pounds of digestible protein, 47.3 pounds of digestible carbohydrates, and 4.2 pounds of digestible fat. This is more protein or flesh-forming food than is contained in 100 pounds of corn or barley, and nearly as much as in a similar quantity of wheat. Henry's figures

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<sup>a</sup> Circular 93, Bureau of Entomology, U. S. Dept. of Agriculture, describes the spring grain-aphis and gives methods for its control.

<sup>b</sup> Farmers' Bulletin 145 gives directions for fumigating grain with carbon bisulphid. Circular 112, Bureau of Entomology, furnishes directions for treatment with hydrocyanic-acid gas.

<sup>c</sup> Henry, W. A. Feeds and Feeding, 9th ed., p. 632.

are based largely on analyses of spring oats, but, as stated, analyses of winter oats show no definite differences in composition. Oats contain only about two-thirds as much digestible carbohydrates as wheat, barley, or corn, but this difference is in part made up by the fact that they contain more than twice as much fat as either barley or wheat. Corn contains slightly more fat than oats.

The feeding value of oat straw is higher than that of the straw of any other small grain and is nearly as great as that of corn stover (fodder with the ears removed). As well-cured oat straw can usually be fed with less waste than corn stover, the actual feeding value of a ton of oat straw is probably equal to that of a ton of corn stover. One hundred pounds of oat straw contain 90.8 pounds of dry matter, while the digestible nutrients in 100 pounds of oat straw consist of 1.2 pounds of protein, 38.6 pounds of carbohydrates, and 0.8 pound of fat.<sup>a</sup>

Oat hay is higher in all the food constituents than timothy hay, which is frequently shipped into the South and sold at high prices. The feeding value of oat hay depends on the proportion of grain to straw. Mature plants of the Red Rustproof variety usually produce about as much grain as straw, while in the Winter Turf variety the weight of the straw is often double that of the grain. As the grain is not fully developed when the crop is cut for hay the proportion of grain to straw in oat hay is less than in the mature plants. Hay made from the Red Rustproof oat is higher in feeding value, ton for ton, than that from the Winter Turf, on account of the greater proportion of grain it contains. On account of the smaller yield, however, the hay from an acre of the Red Rustproof oats usually contains less feed than that from an acre of the Winter Turf.

### FEEDING THE GRAIN TO STOCK.

The high value of oats for feeding to horses and mules is generally well understood. The market price of oats in the South is usually so high that this grain can not be fed with profit to any other class of animals. Even when fed to horses and mules the most economical results can be obtained by substituting corn for a part of the oat ration. Recent experiments show that a small quantity of cottonseed meal can be added to the ration with safety to make up for the deficiency in protein when corn is fed to work stock. If the ration for work stock is made up of equal parts of oats and corn its efficiency will not be decreased, but the cost will be materially lessened, unless corn is unusually high in price. Oats are particularly valuable for

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<sup>a</sup> Henry, *op. cit.*, p. 633.

feeding to colts and to other young and growing stock. The value of this grain for feeding to young animals is due to its high proportion of ash, or bone-forming material, and of protein, or muscle-forming material.

When oats are not too high in price they are a valuable grain for feeding to dairy cows, sheep, and poultry. As they are not fat-producing, they are not of value in fattening cattle, while their high proportion of crude fiber makes oats an inferior feed for hogs. Oats are usually fed whole to all kinds of stock, though for young animals or for older ones with poor teeth the grain should be crushed.

### **OAT STRAW.**

Oat straw, as previously stated, is a better feed than the straw of any other small grain. It is a valuable roughage for feeding to all kinds of stock not at hard work, but contains too much waste material to make up the entire ration. When fed with cowpea or other hay which is high in feeding value it gives bulk to the ration and lessens its cost.

Oat straw is valuable in making and saving manure; when used as bedding it absorbs and holds a large part of the liquid manure. It also adds to the value of the manure, as the ammonia, phosphoric acid, and potash in a ton of oat straw at present prices would cost at least \$3. The straw makes a good mulch for trees, small fruits, and vegetables, but should not be used for this purpose unless it is quite free from weed seeds.

### **OATS AS HAY AND PASTURE AND FOR OTHER PURPOSES.**

Oats make excellent hay, which matures early enough in the season to allow the production of another crop on the land. The yield is heavy, from 1 to 3 tons to the acre, according to the fertility of the soil, and the quality is high. The hay is easily cured and is relished by all kinds of stock. The yield and feeding value may both be increased by growing vetch or some other leguminous crop with the oats.

Good pasture for stock of all kinds is produced by winter oats. As previously stated, however, pasturing the crop usually reduces the yield of grain. When the pasture provided by a winter-grain crop is an important item it is usually better to use wheat or rye, as either of these crops may be pastured quite closely and yet produce a satisfactory crop of grain. If desired, oats may be pastured closely in the spring, then plowed under and the land planted at once to some other crop. Vetch and oats together make good pasture, particularly for sheep and hogs.

As a soiling crop oats can not be used as early in the spring as rye, but the feed produced is of better quality and can be used for a longer period. The quantity of green feed produced by oats is large and the crop can be used over a considerable period. If cut early, a good second crop is produced. Cutting can be begun as soon as the plants begin to show heads and may be continued until the grain is nearly ripe. Green oats are relished by all kinds of stock and there is little waste in feeding. Vetch or crimson clover, grown with the oats, improves the quality of the green feed produced.

Oats are also used as a nurse crop and as a cover crop. The use of winter oats as a nurse crop is rather rare in the South, as grass or leguminous crops are not often sown for the production of permanent meadows. In general, these crops succeed better in the South when seeded without a nurse crop. Where a nurse crop is used, wheat and barley are to be preferred to oats, as they make less shade. As a winter cover crop, to prevent washing of the soil, the value of winter oats has already been stated.

### SUMMARY.

Only a small portion of the area of the Southern States is devoted to the production of oats. The average production for the past ten years of 16 States was about 870,000,000 bushels, or 8.5 per cent of the crop of the United States. The average acre yield was 21.8 bushels and the average acre value \$10.09.

Winter oats are a valuable crop for the South, as they form a soil cover during winter, which prevents washing, and produce considerable quantities of grain and forage for stock.

Winter oats are superior to spring oats in the South, as they mature earlier, provide a soil cover, produce larger yields, and allow more time for the preparation of the land for spring crops.

Two types of winter oats are commonly grown, the Red Rustproof and the Winter Turf. The Red Rustproof is rather less hardy than the Winter Turf, but yields more grain and matures earlier. The latter is recommended for the northern portions of the winter-oat belt and for use as a hay and pasture crop.

Winter oats can be grown in all the Southern States and as far north as Delaware, Maryland, Kentucky, and southern Missouri. The crop is not certain to survive the winter over a large portion of this area, however.

Any soil which will produce a good crop of cotton or corn will grow oats, but the best results are usually secured on one that holds moisture well. Nitrogen should be supplied by growing a leguminous

crop on the land, while potash and phosphoric acid should be provided according to the needs of the soil. Top dressing in the fall with barnyard manure and in the spring with a small quantity of nitrate of soda is recommended.

One of the best rotations for the cotton States includes corn and cowpeas, oats followed by cowpeas, and cotton in a three-year rotation. Outside the cotton belt wheat and a forage crop may take the place of cotton.

The land should be prepared by plowing, disking, and harrowing, so that a loose, mellow seed bed is produced.

The seed should be thoroughly cleaned and graded and only the largest and heaviest grains sown. It should be treated for smut with a solution of formalin.

Early seeding is advisable to secure strong growth of both root and top in the fall. When the seed is drilled the sowing of 2 to 3 bushels to the acre of the Red Rustproof or  $1\frac{1}{2}$  to 2 bushels of the Winter Turf is recommended. Heavier seeding is necessary when the seed is sown broadcast. Sowing with the ordinary grain drill or the specially devised open-furrow drill is to be preferred to broadcast seeding.

Winter grain that is injured by heaving may sometimes be saved by rolling as soon as possible after the injury occurs. Pasturing usually reduces the yield of grain. Fields which have been pastured may be benefited by harrowing.

A small portion of the field should be reserved each year for seeding to a spring variety. If the fall-sown crop winterkills, the large portion should be sown to the spring variety and the small one to the winter variety, in order to secure seed for sowing the following fall.

Rotation of crops, cleaning the seed, and harrowing are advised as methods of keeping down weeds.

Oats are usually cut with a grain binder or with a mower. They should be carefully shocked or cocked to prevent weathering. The grain should be thrashed when thoroughly dry and stored in tight bins. If oats are grown for hay, the crop should be cut before the straw becomes hard, and cured with as little exposure to the weather as possible.

Yields of from 30 to 60 bushels to the acre are not uncommon on good land, while more than 100 bushels to the acre have been produced.

Thorough cleaning of the seed grain each year will improve the yield and quality of the crop. It may be further increased by the selection and testing of individual strains.



The spring grain-aphis is the insect most likely to damage the growing crop; grain weevils and moths attack the stored grain. Rust and smut are the most serious diseases.

Oats are about equal to barley and wheat in feeding value. Corn is a better fattening feed. Oat straw is better than the straw from any other grain. Oat hay is equal to the best timothy hay.

Oats can be fed to all kinds of stock except hogs. They are usually used for feeding to horses and mules, as they are too high in price to feed to other animals. The straw may be used as a feed, as bedding, and as a mulch for fruit crops. Oats may be used for hay or pasture, or as a soiling crop. They may also be used as a nurse crop or as a cover crop.

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